INFLUENCE OF AREA AND YIELD ON THE PRODUCTION OF

URD IN CHHATTISGARH PLAIN

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ABSTRACT

Estimation of Area, Production and Yield of Urd in Chhattisgarh plain and it's constitute districts have been made. Based on this models predicted Area, Production and Yield for the future years 2013- 14 to 2022-23. The productivity of Urd in Chhattisgarh plain and it's constitute districts is expected to increase by the turn of this century, if its present growth trend is maintained. The partial compound growth rate of the area, production and productivity of the crop also be estimated and discussed. Periodic effects of five years as well as annual effects were found to be working in most of the districts. Based on postulated and estimated production function of area and productivity it was found that the major influent factor on the production of crop was its area. This influence of area was around 70% for the whole of Chhattisgarh plain and its constituting districts.

KEYWORDS: Area, Production of Urd, Growth Rate

INTRODUCTION

Urd is also known as black gram (*Vigna mungo*). Archaeological studies have shown that it was cultivated in the country as far back as 2200 B.C. Based on seed color and other characteristics urdbean has been grouped under two main types viz. var. mungo with large black seed and early maturity and var. *viridis* with small greenish seed and late maturity. The green seeded types are locally known as katikahia urd and generally grown as mixed crop with sorghum, pigeonpea and cottton. It is an important pulse crop and serves as a major source of dietary protein for majority of people. It is also cultivated in three different season, viz., kharif, rabi and summer. Although the crop is grown in all the season but maximum area is occupied under kharif season mostly as intercrop with sorghum, pearl-millet, maize, cotton, castor, pigeon pea etc. When intercropped with tall cereals or pigeon pea it smothers weed flora appreciably (20-45%) and consequently minimize the cost incurred on weed control. Urd bean is one of the most important pulse crops of India cultivated over a wide range of agro-climatic situations. The major Urd bean growing states of the country are Maharashtra, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh, Tamilnadu, Karnataka and Rajasthan.

Chhattisgarh is a predominantly tribal and rice growing region. its constituent agro climatic zones are Chhattisgarh plain, Bastar plateau, and Northan hills with 29 districts. Out of which 10 districts belong to Chhattisgarh plain. Being predominantly tribal, Chhattisgarh has been drawing continuous attention of governmental agencies to improve the scenario of crop production. The planners are still not sure of the position of production that will be in the coming year and that of its contributing factors i.e. area and productivity. In Chhattisgarh plain the productivity has increased from 252 kg/ha. to 277 kg/ha. This shows that there had been improvement in yield of Urd.

MATERIALS AND METHODS

The time series secondary data on area, production and productivity Urd for the ten districts of Chhattisgarh plain were collected for the period from 1998-99 to 2012-13 from various issues of publication such as 'Agricultural Statistics' published by Directorate of Agriculture Madhya Pradesh, Bhopal, 'Basic Agricultural Statistics' published by Commissioner of Land Records and Settlement Gwalior, Govt. of Madhya Pradesh and www.cggovt.in .

During analyses it was realized that a five year periodic effect is working on the response variable in most of the district/regions. Therefore, this periodic effect was considered as a structural effect changing every five years the area, production and productivity scenario of Urd crop. A periodic effect variable 'P' was introduced to measure the periodic trend along with the annual effect variable 'T' to measure annual trend with in each period, the following multiple regression models was fitted in all cases using stepwise regression technique as

$$\ln Y = \ln t + bp\, P + bt\, T + \in \text{ or, } \widehat{\ln} Y = \ln t + bp\, P + bt\, T \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (1)$$

Where $\widehat{\ln} Y$ = expected value of the natural logarithm of the response variable Y may be area, productivity or production of a given district/ region; lnt = intercept; P= periodic time variable.

T = annual time variable taking values from 1 to 5 signifying the 1st, 2nd,3rd,4th or 5th, year for any period; bp = partial linear regression coefficient corresponding to variable P; bt = partial linear regression coefficient corresponding to variable T; $\in$ = error/disturbance component normally distributed with mean zero and common variance σ^2, i.e. $\in \sim (0, \sigma^2)$.

Let T be fixed at a particular position in any period, i.e. at 1st, 2nd or 3rd etc. so that it may be considered constant within any period while P varies. Then we may write (1) in the form

$$\widehat{\ln} Y = C + bp\, P, \text{ where } C = \ln t \text{ or, } Y_x = a e^{\theta x}, \text{ where } Y_x = Y, a = e^{c}, \theta = bp, x = P \dots \dots \dots \dots \dots \dots \dots \dots (2)$$

On putting x= 0 and 1 respectively in above equation, we get Y_0 = a and $Y_1 = a e^{\theta} = Y_0(1+r_1)$, where$(1+r_1) = e^{\theta}$,say . Then, we have %$r_1 = \{(Y_p - Y_{p-1})/Y_{p-1}\}$ 100 for fixed T. Also, $r_1 = e^{\theta} - 1 = 1 + \theta - 1 = \theta$ = bp (higher powers of θ in e^{θ} may be ignored). Therefore, r_1 may be defined as the proportional rate of growth in response variable Y per unit change of P for fixed T, ie., a partial compound growth rate. Similarly r_2 and b_t can be interpreted with respected to variable T.

For the influence of area and productivity on the production, we need an additive model with an error term. We have the identity, production = Area × Productivity. However, in actual practice the area, production and productivity are not always reported to be accurate enough to equal to above product, due to probably rounding errors and many a times due to human error in recording the data. Therefore, assuming that actual area, production and productivity are some powers of the reported data and representing the residual discrepancies with an error term, this identity can be written as the functional form:

$$\widehat{\ln} P\,(A, Y) = c_0 + c_1 \ln A + c_2 \ln Y + \acute{\varepsilon} \text{ or, } \widehat{\ln} P\,(A,Y) = c_0 + c_1 \ln A + c_2 \ln Y$$

$$\text{or, } \widehat{P}\,(A,Y) = d_0\, A^{c1}\, Y^{c2,}\, d_0 = e^{c0} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (3)$$

Where A, Y and $\widehat{P}$ (A, P) denoted the area, productivity and estimated production of a given region. The constant c_0 is the intercept and (c_1, c_2) are the partial regression coefficients corresponding to variables lnA and lnY respectively.

RESULTS AND DISCUSSIONS

Compound Growth Analysis

Table 1 shows that Chhattisgarh plain periodic partial compound growth rate in area (-10.908 percent) and production (-10.698 percent) had registered significant at 1% level. Productivity (0.233 percent) had registered non-significant effect. The Annual partial compound growth rate of Chhattisgarh plain in area (-2.821 percent) production (-1.299 percent) percent and productivity (1.567 percent) had registered non- significant.

As for as districts are concern, the periodic partial compound growth rate for area in Raipur (-12.411 percent), Mahasamund (-5.176 percent), Durg (-24.863 percent), Bilaspur, (-22.586 percent), Korba (-4.380 percent), Raigarh (-5.499 percent) had found statistically significant at 1% level. In Dhamtari (-18.451 percent), Rajnandgaon (-18.229 percent), Kawardha (-13.090 percent) and Janjgir (-7.703 percent) had found statistically significant at 5% level. The Annual partial compound growth rate area in Raipur, Mahasamund, Dhamtari, Durg, Rajnandgaon, Kawardha, Bilaspur, Janjgir, Korba, and Raigarh, had registered non- significant.

In the case of production under Urd, we find that the periodic partial compound growth rate in Mahasamund (-17.427 percent), Durg (-19.872 percent) and found statistically significant at 1% whereas Dhamtari (-18.693 percent), Rajnandgaon (-16.086 percent), Bilaspur (-17.430 percent), Janjgir (-6.470 percent) found statistically significant at 5% level. Rest of the districts Raipur, korba, Kawardha and Raigarh had registered non significant. Annual partial compound growth rate of production in all the districts were observed non-significant.

Production Function

Our interest is to find the extent of influence of area and productivity on the production of pulses in Chhattisgarh plain. For that we need an additive model with an error term. We have the identity, production = Area × Productivity. However, in actual practice the area, production and productivity are not always reported to be accurate enough to equal to above product, due to probably rounding errors and many a times due to human error in recording the data. Therefore, assuming that actual area, production and productivity are some powers of the reported data and representing the residual discrepancies with an error term, this identity can be written in the functional form is given by equation 3(a,b,c).

Urd the estimated functions in terms of area and yield have been presented for all the district and Chhattisgarh plain in Table 2, The production function satisfactorily fits to the data on indicated by more than 60% except Dhamtari and Kawardha. The highest value of R^2 recorded 93.540 percent for Durg. column (1) and (2) showed that in most of the district's the area influences the production of Pea by more than 68.009 percent barring the districts Mahasamund, Dhamtari, Rajnandgaon, Kawardha,and Janjgir. The production was influenced by the productivity.

Prediction of Area, Yield and Production

Figure 1, 2, 3 shows the prediction of area, production and productivity of Urd between 2013-14 to 2022-23 in Chhattisgarh plain 10 districts namely Raipur, Mahasamund, Dhamtari, Durg, Rajnandgaon, Kawardha, Bilaspur, Janjgir, Korba and Raigarh.

**Table 1: Prediction Models (W. R. T. Time) of Area, Productivity and Production
under Urd for Chhattisgarh Plain and its Constitute Districts**

Districts/Region		lnt	bp	%r₁ @	bt	% r₂ @	% R²
Raipur	A	2.084	-0.132***	(-12.411***)	-0.040	(-3.864)	86.070
	Y	6.074	-0.047	(-4.583)	-0.049	(-4.736)	9.337
	P	0.690	-0.044	(-4.367)	-0.020	(-2.002)	9.920
Mahasamund	A	2.534	-0.053***	(-5.176***)	-0.009	(-0.887)	51.922
	Y	6.320	-0.200***	(-18.057***)	-0.029	(-2.811)	61.472
	P	1.662	-0.191***	(-17.427***)	0.003	(0.318)	44.403
Dhamtari	A	0.946	-0.203**	(-18.451**)	-0.108	(-10.203)	43.150
	Y	6.279	-0.150**	(-13.990**)	-0.060	(-5.730)	32.074
	P	-0.293	-0.207**	(-18.694**)	-0.094	(-9.029)	33.634
Durg	A	2.250	-0.286***	(-24.863***)	-0.071	(-6.906)	82.907
	Y	5.942	-0.082	(-7.943)	-0.047	(-4.571)	21.428
	P	0.672	-0.221***	(-19.872***)	-0.044	(-4.398)	72.280
Rajnand gaon	A	2.516	-0.201**	(-18.229**)	-0.022	(-2.184)	38.847
	Y	6.080	-0.096	(-9.117)	-0.026	(-2.540)	22.650
	P	1.170	-0.176**	(-16.086**)	0.017	(1.676)	20.020
Kawardha	A	1.466	-0.140**	(-13.090**)	-0.063	(-6.153)	35.463
	Y	6.016	-0.043	(-4.216)	-0.032	(-3.239)	6.892
	P	0.024	-0.052	(-5.090)	-0.030	(-2.973)	4.496
Bilaspur	A	1.562	-0.257***	(-22.586***)	-0.071	(-6.884)	79.113
	Y	5.790	-0.060	(-5.836)	-0.066	(-6.336)	14.200
	P	-0.073	-0.191**	(-17.430**)	-0.074	(-7.223)	52.436
Janjgir	A	0.767	-0.080**	(-7.703**)	-0.008	(-0.723)	31.650
	Y	6.043	-0.124	(-11.690)	-0.067	(-6.478)	33.759
	P	-0.662	-0.067**	(-6.470**)	-0.009	(-0.842)	25.239
Korba	A	1.711	-0.044***	(-4.380***)	-0.013	(-1.302)	86.210
	Y	5.280	-0.002	(-0.241)	0.012	(1.240)	4.730
	P	0.067	-0.043	(-4.254)	0.001	(0.180)	18.177
Raigarh	A	3.120	-0.057***	(-5.499***)	-0.0150	(-1.483)	74.440
	Y	5.260	0.046**	(4.653**)	0.0099	(0.988)	23.766
	P	1.464	-0.010	(-0.944)	-0.0042	(-0.426)	2.410
Plain Zone	A	4.432	-0.116***	(-10.908***)	-0.0287	(-2.821)	86.257
	Y	5.538	0.002	(0.233)	0.0156	(1.567)	9.693
	P	3.062	-0.113***	(-10.6998***)	-0.0130	(-1.299)	51.281

*Significant at 10% level, ** significant at 5% level, *** significant at 1% level @ %r₁ & %r₂ indicate the growth

rates (in percentages) Corresponding to bp and bt respectively.

**Table 2: Production Function as Influenced by the Area and Productivity of
Urd in Chhattisgarh Plain and its Constituent Districts**

Districts/Region	Production Function							(1)*	(2)$	(3)@
RAIPUR	ln P (A, Y) =	4.856	-	1.153	ln A	+	0.073	ln Y	83.993	1.212	85.207
MAHASAMUND	ln P (A, Y) =	7.780	-	0.810	ln A	-	0.430	ln Y	46.280	21.648	67.928
DHAMTARI	ln P (A, Y) =	4.418	-	0.179	ln A	-	0.182	ln Y	36.320	4.796	41.117
DURG	ln P (A, Y) =	2.451	-	0.694	ln A	+	0.334	ln Y	84.576	8.964	93.540
RAJNANDGAON	ln P (A, Y) =	6.832	-	0.354	ln A	-	0.480	ln Y	31.664	30.373	62.039
KAWARDHA	ln P (A, Y) =	3.244	-	0.400	ln A	+	0.081	ln Y	30.857	0.863	31.720
BILASPUR	ln P (A, Y) =	3.269	-	0.596	ln A	+	0.100	ln Y	81.357	2.380	83.737
JANJGIR	ln P (A, Y) =	6.244	-	0.821	ln A	-	0.438	ln Y	26.311	43.203	69.516
KORBA	ln P (A, Y) =	9.659	-	3.340	ln A	-	0.199	ln Y	86.067	1.024	87.090
RAIGARH	ln P (A, Y) =	11.128	-	2.339	ln A	-	0.163	ln Y	68.009	0.446	68.453
PLAIN ZONE	ln P (A, Y) =	6.784	-	1.287	ln A	+	0.328	ln Y	81.948	2.192	84.140

* Percent sum of squares explained by lnA, i.e. area effects

$ Percent sum of squares explained by inY, i.e. yield effect

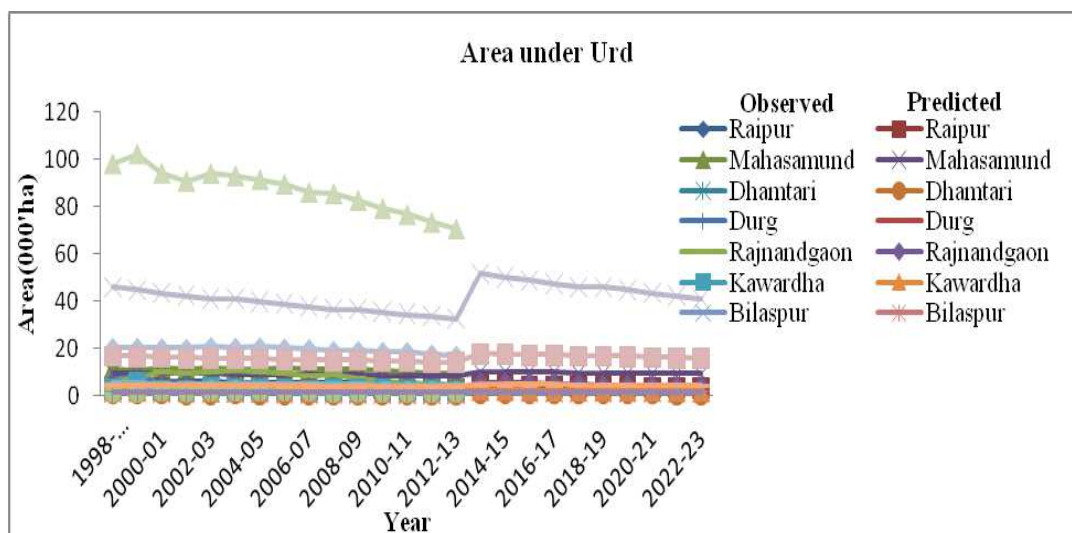@ total percent sum of squares explained by lnP(A, Y) i.e., by the model (3)

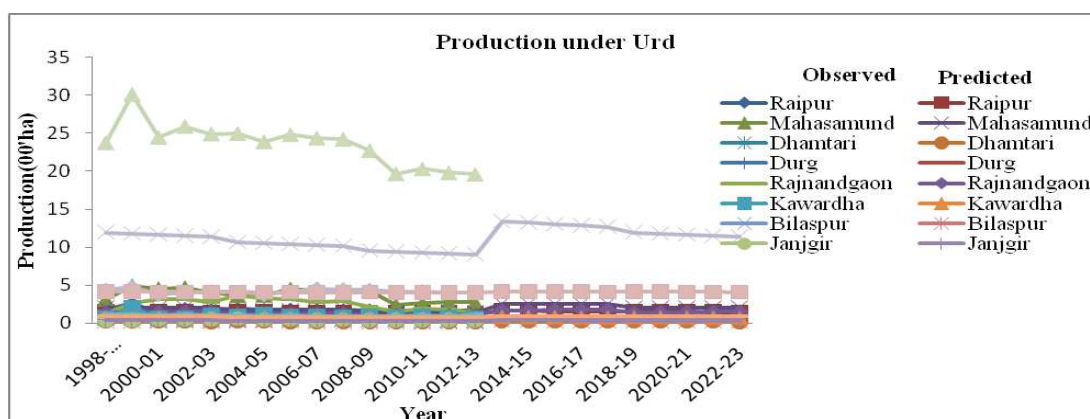**Figure 1: Show the Prediction of Area of Urd between 2013-14 to 2022-23**

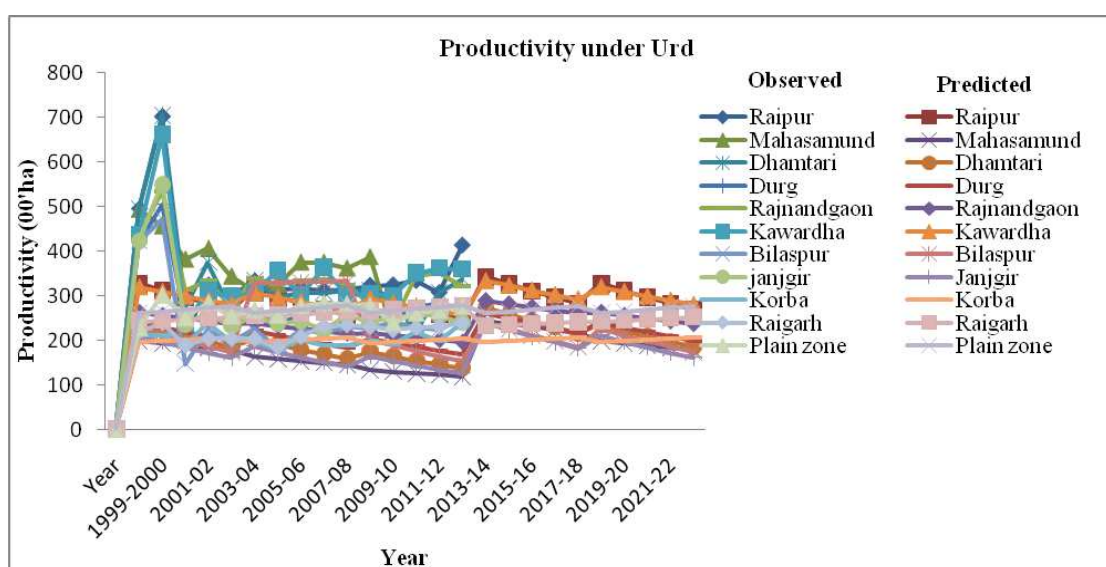**Figure 2: Show the Prediction of Production of Urd between 2013-14 to 2022-23**

Figure 3: Show the Prediction of Productivity of Urd between 2013-14 to 2022-23

CONCLUSIONS

In Chhattisgarh plain the periodic partial compound growth rate in area (-10.908 percent) and production (-10.699 percent) and significant at 1% level. whereas productivity is non-significant. The Annual partial compound growth rate for area, production and productivity are non- significant. As for as districts are concern, the periodic partial compound growth rate for area in Raipur (-12.411 percent), Mahasamund (-5.176 percent), Durg (-24.863 percent), Bilaspur,(-22.586 percent), Korba (-4.380 percent), Raigarh (-5.499 percent) had found statistically significant at 1% level. In Dhamtari (-18.451 percent), Rajnandgaon (-18.229 percent), Kawardha (-13.090 percent) and Janjgir (-7.703 percent) and significant at 5% level. The Annual partial compound growth rate for area in Raipur, Mahasamund, Dhamtari, Durg, Rajnandgaon, Kawardha, Bilaspur, Janjgir, Korba, and Raigarh, non- significant. In the case of production under Urd, we find that the periodic partial compound growth rate in Mahasamund (-17.427 percent), Durg (-19.872 percent) and found statistically significant at 1% whereas Dhamtari (-18.694 percent), Rajnandgaon (-16.086 percent), Bilaspur (-17.430 percent),Janjgir (-6.470 percent) found statistically significant at 5% level. Rest of the districts Raipur, korba, Kawardha and Raigarh had registered non significant. Annual partial compound growth rate of production in all the districts were observed non-significat. For the productivity of Urd the periodic partial compound growth rate in Mahasamund (-18.057 percent) had found significant at 1% level whereas Dhamtari (-13.990 percent) and Raigarh (4.653 percent) respectively had and significant at 5% level. In Raipur, Durg, Rajnandgaon, Kawardha, Bilaspur, Janjgir and Korba Periodic partial compound growth rate non-significant. Annual partial compound growth rate of production in all the districts were observed non-significant.

The production function satisfactorily fits to the data on indicated by more than 60% except Dhamtari and Kawardha. The highest value of R^2 recorded 93.540 percent for Durg. The area influence the production of Urd by more than 68.008 percent barring the districts Mahasamund, Dhamtari, Rajnandgaon, Kawardha,and Janjgir. The production was influenced by the productivity and only a little contribution is made by the area.

It is seen that in Rajnandgaon, Korba and Raigarh for Arhar found satisfactorily fits to the data on indicated by more than 60%. This model showed highest R^2 up to 81.802 percent for Korba. the production influence by the area of Arhar by more than 27.337 percent barring the districts Raipur, Mahasamund, Durg, Bilaspur, Janjgir, Bilaspur and Raigarh. For the district Mahasamund, Durg the productivity was influenced by the production and only a little contribution is made by the area.

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